clay sinks further west towards Wiltshire. The lowest zone of the Gault in Surrey that has the typical clayey facies is equivalent to the fourth or higher zone of the Folkestone Gault, the lower zones being represented in the so-called "Folkestone Sands." Dr. Gregory indicates the levels at which, in Kent and Surrey respectively, the limits of the Albian, Upper and Lower Aptian, and Rhodanian formations of the Continent can be drawn; but insists on the necessity of continuing to recognise the old lithological divisions side by side with the new palæontological ones. He also gives a critically revised and extended list of fossils from the phosphate beds of Great Chart, near Ashford, Kent.

THE 1894 "Report of Observations of Injurious Insects and common Farm Pests," by Eleanor A. Ormerod, will not yield to any of its predecessors in interest, value, or variety. The general character of these Reports is so well known that it is unnecessary to dwell upon it; but the present part gives prominence to several considerations which have not hitherto received very much attention. The first of these is the undoubted fact that almost any of the 12,000 species of insects inhabiting the British Islands, except those which feed exclusively on other insects, may, under certain circumstances, or when unusually abundant, become entitled to a place in the category of injurious insects. Thus, the present Report opens with figures and descriptions of three species of *Lepidoptera*—the Eyed Hawk Moth, the Lappet Moth, and the large Tortoiseshell Butterfly—which are not generally so common in England as to be thought capable of causing serious injury; indeed, Miss Ormerod herself suggests that such pests might easily be got rid of by inviting an entomologist to clear them off. One of the most important insect visitations during the past year was that of the Antler Moth (*Charæas graminis*) in South Scotland, where the larvæ fed on the tender grass which sprang up over the districts previously devastated by the vole plague. Several pages are devoted to hay mites, which appear, however, though sometimes excessively abundant, to cause little real damage. Other interesting creatures noticed are the eel-worms (in her account of which Miss Ormerod has unintentionally in part anticipated Prof. Percival's important paper on the subject in *Natural Science* for March, as fully explained in an accompanying note), horse-warble, winter gnats, wasps, &c. It does not appear to be quite certain whether the horse-warble is the same species as the ox-warble. Warble in the horse appears to be of much less common occurrence than in the ox, and usually to occur only in small numbers in the same animal. But this may be due to the horse being a more carefully-tended animal than the ox. Two other points of interest deserve notice. Several species of carnivorous ground-beetles are stated to be very destructive to strawberries. More information is certainly required as to how far so-called carnivorous insects will also eat vegetable matter, decaying or otherwise. It appears that sea-gulls are sometimes in the habit of frequenting turnip-fields infested with the Diamond Back Moth, and in one instance a farmer attributed the destruction of his crop to the gulls. So easy is it to make a serious error in discriminating between the farmer's friends and foes.

A NEW and particularly convenient method of preparing the unsaturated hydrocarbon allylene, C_3H_4, has been discovered by Prof. Keiser and Miss M. B. Breed, as the result of an investigation concerning the action of magnesium upon the vapours of the alcohols. Preliminary experiments showed that when magnesium is heated with organic compounds such as alcohols, acids, and ketones, a reaction of considerable energy occurs at more or less elevated temperatures, accompanied by incandescence of the metal. The reactions between magnesium and the alcohols were then systematically studied. The magnesium, in the form of filings, was placed in a porcelain boat, and heated in a combustion tube through which the vapour of the alcohol was conducted. At a low red-heat the magnesium usually commenced to glow at one end of the boat, and the incandescence was then rapidly communicated to the whole quantity of metal, while large volumes of gas were evolved from the tube. When methyl alcohol is employed the action is extremely energetic, and the gases evolved consist mainly of about four-fifths hydrogen and one-fifth marsh gas. The residue in the boat is then allowed to cool in the vapour of the alcohol, when it is found to have the appearance of a black coherent mass. When this solid residue is placed in water a gas is slowly evolved, and if a few drops of ammonium chloride are added, the gas is liberated in a steady and moderately rapid current. The odour of the gas resembles that of acetylene, but when it is conducted through an ammoniacal solution of cuprous chloride the greenish yellow precipitate of cuprous allylide is produced, and with an ammoniacal silver nitrate solution the white crystalline precipitate of silver allylide is formed. These precipitates are highly explosive after separation and drying, a temperature of 150° being sufficient to bring about their explosion. When they are treated with dilute nitric or hydrochloric acids they dissolve with evolution of allylene. Ethyl alcohol behaves similarly towards heated magnesium, and the black residue left in the boat after the completion of the reaction is similarly decomposed by water with liberation of allylene, the rapidity of evolution of the latter being also largely augmented by the addition of a little ammonium chloride. The most convenient alcohol to employ, however, is propyl alcohol, for the black magnesium residue is in this case decomposed much more rapidly by water at the ordinary temperature, and the yield of gas is considerably larger. Prof. Keiser states that this method of preparing allylene for lecture purposes, by the reaction between magnesium and propyl alcohol, and subsequent decomposition of the product by water, is far preferable to the ordinary method of decomposing propylene bromide with alcoholic potash. Most of the other alcohols likewise afford magnesium residues which liberate allylene when brought in contact with water, but the gas is rarely so pure as that derived from the use of propyl alcohol.

THE additions to the Zoological Society's Gardens during the past week include a Macaque Monkey (*Macacus cynomolgus*, ♂) from India, presented by Mrs. Turner-Turner; an Azara's Fox (*Canis azaræ*) from Brazil, presented by Messrs. Edgar and Harold Turner; four Amadavade Finches (*Estrelda amandava*) from India, presented by Mrs. Faulkenor; a Chukar Partridge (*Caccabis chukar*) from India, deposited; a Sykes's Monkey (*Cercopithecus albigularis*, ♀) from East Africa, two Red-crested Pochards (*Fuligula rufina*, ♂ ♀) from India, purchased; a Great Kangaroo (*Macropus giganteus*, ♂), three Hunter's Spiny Mice (*Acomys hunteri*) born in the Gardens.

OUR ASTRONOMICAL COLUMN.

SPECTRUM OF THE ORION NEBULA.—A full account of the photographs of the spectrum of the Orion Nebula, which were taken with Mr. Lockyer's 30-inch reflector at Westgate-on-Sea in 1890, has just been published in the *Philosophical Transactions* (vol. 186 A, p. 73.) Four hydrogen lines more refrangible than K are shown on the photographs, and in all 54 lines have been recorded. The line near wave-length 3730, first discovered by Dr. Huggins, is a very strong line, and among other prominent lines, is the well-known chromospheric line at wave-length 4471. It is shown that many of the principal lines are coincident with bright lines photographed in the spectrum of P Cygni at South Kensington, and with bright lines in planetary nebulæ and bright line-stars photographed by Campbell and Pickering, so that a close connection of these bodies is

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established. Other tables show a close relationship between the bright lines of the nebula and the dark lines in the so-called Orion stars, of which Rigel and Bellatrix are typical examples.

The following are the conclusions to which the investigation has led: (1) The spectrum of the nebula of Orion is a compound one, consisting of hydrogen lines, low temperature, metallic lines and flutings, and high temperature lines. The mean temperature, however, is relatively low. (2) The spectrum is different in different parts of the nebula. (3) The spectrum bears a striking resemblance to that of the planetary nebulæ and bright-line stars. (4) The suggestion, therefore, that these are bodies which must be associated in any valid scheme of classification is strengthened. (5) Many of the lines which appear bright in the spectrum of the nebula, appear dark in the spectra of stars of Groups II. and III., and in the earlier stars of Group IV.; a gradual change from bright to dark lines has been found. (6) The view, therefore, that bright-line stars occupy an intermediate position between nebulæ and stars of Group III. is greatly strengthened by these researches.

THE ECLIPSE OF THE MOON.—The earlier phases of the total eclipse of the moon on Monday morning were observed under very favourable circumstances in the neighbourhood of London. The penumbra was not distinctly visible until about ten minutes before contact with the shadow, and the whole disc of the moon remained clearly visible, even at the middle of totality, until clouds stopped observations about 4 a.m. The parts deeply immersed in shadow were intensely red throughout, and with the telescope all the principal formations could be easily distinguished. During totality the sky was exceptionally clear, and numerous occultations were observed without difficulty. For half an hour after the commencement of totality the following edge of the moon was pretty brightly illuminated, and presented a striking contrast with the redness of the advancing edge; at mid-eclipse, however, the whole of the disc was very red.

It is reported that nearly 140 observations of disappearances or reappearances of eighteen stars were secured at the Royal Observatory on Monday morning by the eleven observers who watched the progress of the eclipse.

THE NAUTICAL ALMANAC, 1898.—In the recently published volume of the British Ephemeris for 1898, we note several valuable additions. The places of eleven close circumpolar stars, four of which are in the northern hemisphere, are given for each day of the year, and the mean places of fifty two additional stars for navigational purposes have been added. The improved explanations of the contents will also no doubt be generally appreciated. The publication of an abridged edition for the use of seamen is a step in the right direction.

PHYSICAL WORK OF HERMANN VON HELMHOLTZ.[1]

I

THE career we are to consider this evening was a career of singular distinction. In days when the range of "natural knowledge" is so vast that most workers are compelled to be content if they can add something to one or two of the subdivisions of one of the main branches of science, von Helmholtz showed us that it is not impossible to be at once a great mathematician, a great experimental physicist, and, in the widest sense of the term, a great biologist.

It was but eight months yesterday since he delivered his last lecture; it is six months to-day since he died, and the interval is too short for us to attempt to decide on the exact place which will be assigned to him by posterity; but making all allowance for the fact that each age is apt to place its own great among the greatest, making all allowance for the spell which his name cast over many of us in the lecture-rooms where we ourselves first gained some knowledge of science, I am sure that I only express the views of all those who know his work best, when I say that we place him in the very front rank of those who have led the great scientific movement of our time. This opinion I have now to justify. I must try to convey to you in some sixty minutes an outline of the work of more than fifty strenuous years, to give you some idea of the wide range of the multifold activities which were crowded into them, of the marvellous insight with which the most diverse problems were attacked and solved, and, if it may be, some image of the man himself. The task is impossible, and I can but attempt some fragments of it.

The history of von Helmholtz is in one respect a simple tale. There are no life and death struggles with fate to record. His work was not done with the wolf at the door, or while he himself was wrestling with disease. He passed through no crises in which success or failure, immortality or oblivion, seemed to depend on the casting of a die. He suffered neither from poverty nor riches. He was a hale strong man on whom external circumstances neither imposed exceptional disabilities, nor conferred exceptional advantages, but who, by sheer force of the genius that was in him, passed on from success to success till he was recognised by all as the admirable Crichton of modern science, the most widely cultivated of all students of nature, the acknowledged leader of German science, and one of the first scientific men in the world.

It is the more fitting that this evening should have been set aside for the consideration of the work of Helmholtz, in that England may claim some share in his greatness. Before her marriage his mother bore an English name—Caroline Penn; she was, as her name implied, of English descent. His father was a Professor of Literature in the Gymnasium at Potsdam, so that his early days were passed amid that plain living and high thinking which are characteristic of intellectual circles in Germany. The boy did well at school, and when the time came for choosing a profession, his passion for mathematics and physics had already developed itself. The course of his love for these sciences did not run quite smooth. The path of his ambition was crossed by the hard necessity which in some cases checks, in others fosters, but in all chastens the aspirations of youth. He had to make his livelihood. Science must be to him what the Germans happily call a "bread-study." Medicine offered a fair prospect of prosperity. Physics, in those days, was but an intellectual pastime. And so the young man took his father's advice, and became an army doctor. In this, as in so many other cases, "the path of duty was the way to glory."

It is possible that if von Helmholtz had been what—with a sad consciousness of the limitations it implies—I may call a mere physicist, he would have played a greater part in the development of some of those subjects, the study of which he initiated or helped to initiate, but did not thereafter pursue. It is possible that had he been a biologist, and nothing more, he would have followed up the early investigation in which he disproved the old theory that putrefaction and fermentation are chemical processes only, clearly indicating, if he did not actually demonstrate, that the decay which follows death is due to an outburst of low forms of life.

He might thus under other circumstances have done work for which he showed his competence, but which is now chiefly associated with other names; but it is certain that without the unusual combination of wonderful mathematical power and a professional knowledge of anatomy, he would never have accomplished the special tasks which it is his special glory to have achieved.

His first three papers, however, hardly displayed the fusion between his various powers which was afterwards so remarkable a characteristic of his work. The first two were on biological subjects. The third was the famous essay on the "Conservation of Force." I have told elsewhere the story of the dramatic circumstances under which it was given to the world, of the interest it excited among the members of the Physical Society of Berlin, the refusal of the editor of *Poggendorff's Annalen* to publish it, and the final triumph of the author and his views. (*Fortnightly Review*, November 1894.) Helmholtz was not, and did not claim to be an original author of the doctrine of the conservation of energy; but two young men, Sir William Thomson in England, and Helmholtz in Germany, independently, and within a month of each other, were the first persons who compelled the scientific world to regard it seriously.

There is one interesting fact which connects this essay directly with the Royal Institution. Four years after it was published, it was placed by Du Bois Reymond in the hands of one who was lost to science in the same year as von Helmholtz himself—the late Prof. Tyndall. He was much impressed, and has spoken of the incident as bringing him face to face with the great doctrine of the "Conservation of Energy." ("Introduction to Popular Lectures by Helmholtz," translated by E. Atkinson, 1873.) He translated the essay into English, and

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[1] A discourse delivered at the Royal Institution, by Prof. A. W. Rücker, F.R.S., on Friday, March 8.

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